19-2902; Rev 0; 7/03

# SOT23封装、USB/AC适配器双输入、单节Li+电池充电器



## 概述

MAX1551/MAX1555可以从 USB*或 AC适配器电源为单节 Li+电池提供充电。它们无需外部场效应管或二极管即可工作，并可工作在高达 7V的输入电压。

片上温度限制电路简化了 PC板的布局，并允许优化充电速率，使其在电池状况最差、输入电压最高的情况下不会达到温度限制值；而当 MAX1551/MAX1555达到温度限制的门限时，充电器不会关断，而是逐步减小充电电流。

MAX1551包含一个 $\overline{POK}$输出，用于指示是否连接了输入电源。任何一路充电电源有效，$\overline{POK}$会置为低电平。MAX1555则利用 $\overline{CHG}$输出指示充电状态。

当与 USB连接、但没有 DC电源时，充电电流被置为 100mA (最大值)。这样，加电或未加电的 USB集线器均可用于充电，无需端口通信。当连接了 DC电源时，充电电流被置为 280mA (典型值)。无须使用输入屏蔽二极管来防止电池漏电。

MAX1551/MAX1555采用 5引脚、薄型 SOT23封装，工作在 -40℃至 +85℃温度范围内。

## 应用

PDA

无线设备

蜂窝电话

数码相机

## 特性

- ♦ 使用 USB或 AC适配器进行充电
- ♦ 插入 AC适配器时可自动进行切换
- ♦ 片上温度限制电路简化电路板设计
- ♦ 充电状态指示
- ♦ 5引脚、薄型 SOT23封装
- ♦ 受美国专利 #6,507,172保护

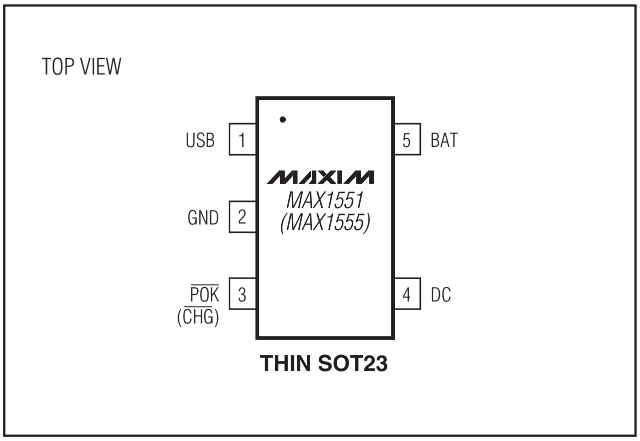
## 定购信息

| PART | TEMP RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX1551**EZK-T | -40°C to +85°C | 5 Thin SOT23-5 |
| **MAX1555**EZK-T | -40°C to +85°C | 5 Thin SOT23-5 |

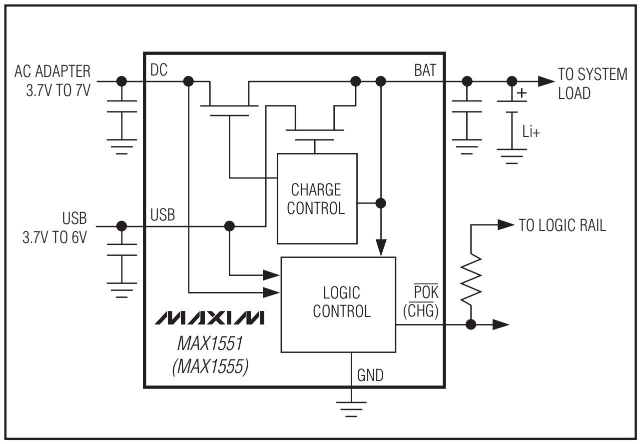
## 选择指南

| PART | TOP MARK | FEATURES |
|---|---|---|
| MAX1551EZK | ADRT | $\overline{POK}$ Output |
| MAX1555EZK | ADRU | $\overline{CHG}$ Output |

## 引脚配置




## 典型工作电路




*Protected by U.S. Patent #6,507,172.

## ABSOLUTE MAXIMUM RATINGS

DC to GND ....................0 to +8V
DC to BAT ....................0 to +7V
BAT, $\overline{CHG}$, $\overline{POK}$, USB to GND ....................-0.3V to +7V
Continuous Power Dissipation ($T_A$ = +70°C)
5-Pin Thin SOT23 (derate 9.1mW/°C above +70°C)....727mW
Operating Temperature Range ....................-40°C to +85°C
Junction Temperature Range ....................-40°C to +150°C
Storage Temperature Range ....................-65°C to +150°C
Lead Temperature (soldering, 10s) ....................+300°C

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## ELECTRICAL CHARACTERISTICS

($V_{DC}$ = 5V, $V_{USB}$ = 0, $I_{BAT}$ = 0, $C_{BAT}$ = 1µF, **$T_A$ = 0°C to +85°C**, unless otherwise noted.)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| **DC** | | | | | |
| DC Voltage Range | (Note 1) | 3.7 | | 7.0 | V |
| DC to BAT Voltage Range | | 0.1 | | 6.0 | V |
| DC Undervoltage Lockout Threshold | Input rising, 430mV hysteresis, $V_{BAT}$ = 3V (Note 1) | 3.75 | 3.95 | 4.15 | V |
| DC Supply Current | | | 1.75 | 3 | mA |
| DC to BAT On-Resistance | $V_{DC}$ = 3.7V, $V_{BAT}$ = 3.6V | | 1 | 2 | Ω |
| DC to BAT Dropout Voltage | When charging stops, $V_{BAT}$ = 4V, DC falling, 200mV hysteresis | 30 | 60 | 90 | mV |
| **USB** | | | | | |
| USB Voltage Range | (Note 1) | 3.7 | | 6.0 | V |
| USB Undervoltage Threshold | Input rising, 430mV hysteresis, $V_{DC}$ = 0, $V_{BAT}$ = 3V (Note 1) | 3.75 | 3.95 | 4.15 | V |
| USB Supply Current | $V_{USB}$ = 5V, $V_{DC}$ = 0 | | 1.65 | 3 | mA |
| USB to BAT On-Resistance | $V_{USB}$ = 3.7V, $V_{BAT}$ = 3.6V, $V_{DC}$ = 0 | | 2 | 4 | Ω |
| USB to BAT Dropout Voltage | When charging stops, $V_{BAT}$ = 4V, USB falling, 200mV hysteresis, $V_{DC}$ = 0 | 30 | 60 | 90 | mV |
| **BAT** | | | | | |
| BAT Regulation Voltage | $V_{DC}$ or $V_{USB}$ = 5V | 4.158 | 4.2 | 4.242 | V |
| DC Charging Current | $V_{BAT}$ = 3.3V, $V_{USB}$ = 0, $V_{DC}$ = 5V | 220 | 280 | 340 | mA |
| USB Charging Current | $V_{BAT}$ = 3.3V, $V_{DC}$ = 0, $V_{USB}$ = 5V | 80 | 90 | 100 | mA |
| BAT Prequal Threshold | $V_{BAT}$ rising, 100mV hysteresis | 2.9 | 3 | 3.1 | V |
| Prequalification Charging Current | $V_{BAT}$ = 2.8V | 20 | 40 | 80 | mA |
| BAT Leakage Current | $V_{DC}$ = $V_{USB}$ = 0, $V_{BAT}$ = 4.2V | | | 5 | µA |
| **$\overline{POK}$, $\overline{CHG}$, AND THERMAL LIMIT** | | | | | |
| $\overline{CHG}$ Threshold | Charge current where $\overline{CHG}$ goes high, $I_{BAT}$ falling, 50mA hysteresis | 25 | 50 | 100 | mA |
| $\overline{CHG}$, $\overline{POK}$ Logic-Low Output | $I_{\overline{CHG}}$, $I_{\overline{POK}}$ = 10mA | | 150 | 300 | mV |
| $\overline{CHG}$, $\overline{POK}$ Leakage Current | $V_{\overline{CHG}}$, $V_{\overline{POK}}$ = 6V, $T_A$ = +25°C | | 0.001 | 1 | µA |
| Thermal-Limit Temperature | Charge current reduced by 17mA/°C above this temperature | | +110 | | °C |

## ELECTRICAL CHARACTERISTICS

($V_{DC}$ = 5V, $V_{USB}$ = 0, $I_{BAT}$ = 0, $C_{BAT}$ = 1µF, **$T_A$ = -40°C to +85°C**, unless otherwise noted.) (Note 2)

| PARAMETER | CONDITIONS | MIN | MAX | UNITS |
|---|---|---|---|---|
| **DC** | | | | |
| DC Voltage Range | (Note 1) | 3.7 | 7.0 | V |
| DC to BAT Voltage Range | | 0.1 | 6.0 | V |
| DC Undervoltage Lockout Threshold | Input rising, 430mV hysteresis, $V_{BAT}$ = 3V (Note 1) | 3.75 | 4.15 | V |
| DC Supply Current | | | 3 | mA |
| DC to BAT On-Resistance | $V_{DC}$ = 3.7V, $V_{BAT}$ = 3.6V | | 2 | Ω |
| DC to BAT Dropout Voltage | When charging stops, $V_{BAT}$ = 4V, DC falling, 200mV hysteresis | 30 | 95 | mV |
| **USB** | | | | |
| USB Voltage Range | (Note 1) | 3.7 | 6.0 | V |
| USB Undervoltage Lockout Threshold | Input rising, 430mV hysteresis, $V_{DC}$ = 0, $V_{BAT}$ = 3V (Note 1) | 3.75 | 4.15 | V |
| USB Supply Current | $V_{USB}$ = 5V, $V_{DC}$ = 0 | | 3 | mA |
| USB to BAT On-Resistance | $V_{USB}$ = 3.7V, $V_{BAT}$ = 3.6V, $V_{DC}$ = 0 | | 4 | Ω |
| USB to BAT Dropout Voltage | When charging stops, $V_{BAT}$ = 4V, USB falling, 200mV hysteresis, $V_{DC}$ = 0 | 30 | 95 | mV |
| **BAT** | | | | |
| BAT Regulation Voltage | $V_{DC}$ or $V_{USB}$ = 5V | 4.141 | 4.259 | V |
| DC Charging Current | $V_{BAT}$ = 3.3V, $V_{USB}$ = 0, $V_{DC}$ = 5V | 220 | 340 | mA |
| USB Charging Current | $V_{BAT}$ = 3.3V, $V_{DC}$ = 0, $V_{USB}$ = 5V | 80 | 100 | mA |
| BAT Prequal Threshold | $V_{BAT}$ rising, 100mV hysteresis | 2.9 | 3.1 | V |
| Prequalification Charging Current | $V_{BAT}$ = 2.8V | 20 | 80 | mA |
| BAT Leakage Current | $V_{DC}$ = $V_{USB}$ = 0, $V_{BAT}$ = 4.2V | | 5 | µA |
| **$\overline{POK}$, $\overline{CHG}$** | | | | |
| $\overline{CHG}$ Threshold | Charge current where $\overline{CHG}$ goes high, $I_{BAT}$ falling, 50mA hysteresis | 25 | 100 | mA |
| $\overline{CHG}$, $\overline{POK}$ Logic-Low Output | $I_{\overline{CHG}}$, $I_{\overline{POK}}$ = 10mA | | 300 | mV |
| $\overline{CHG}$, $\overline{POK}$ Leakage Current | $V_{\overline{CHG}}$, $V_{\overline{POK}}$ = 6V, $T_A$ = +25°C | | 1 | µA |

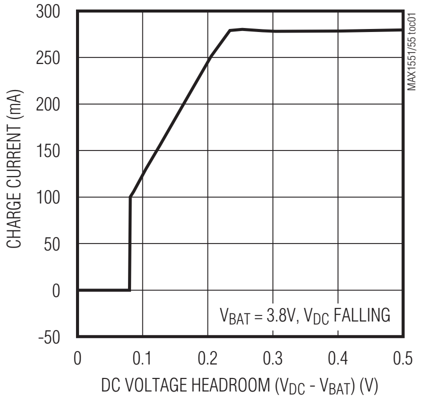
**Note 1:** The input undervoltage lockout has 430mV of hysteresis. The charger turns on when an input rises to 3.95V (typ), and turns off when it falls below 3.52V.

**Note 2:** Specifications to -40°C are guaranteed by design, not production tested.

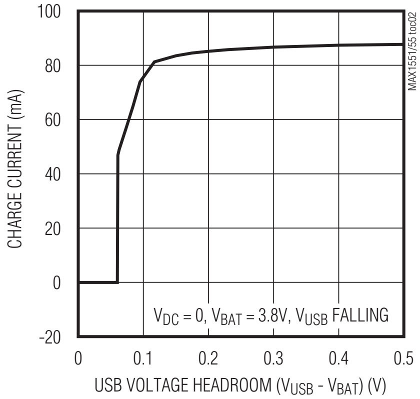
## 典型工作特性

($V_{DC}$ = 5V, $V_{USB}$ = 0, $I_{BAT}$ = 0, $C_{BAT}$ = 1μF, $T_A$ = +25°C, unless otherwise noted.)

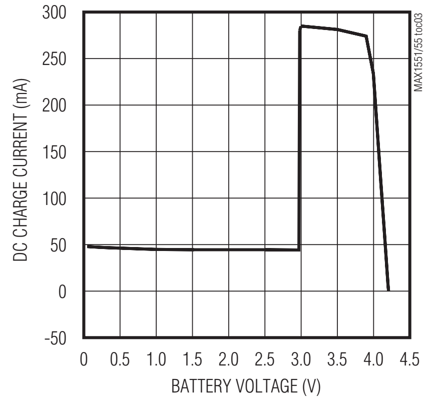
**CHARGE CURRENT vs. DC VOLTAGE HEADROOM**



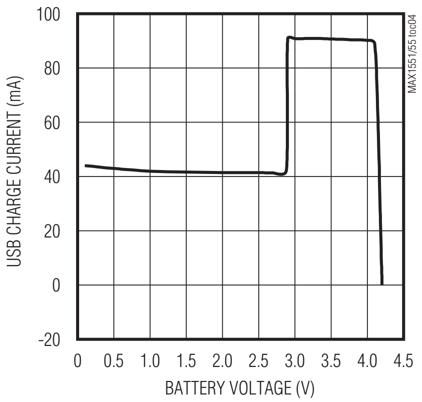

**CHARGE CURRENT vs. USB VOLTAGE HEADROOM**



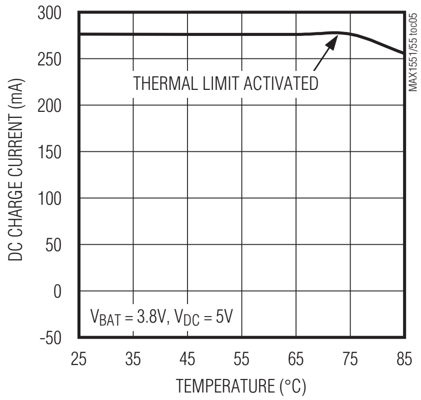

**DC CHARGE CURRENT vs. BATTERY VOLTAGE**



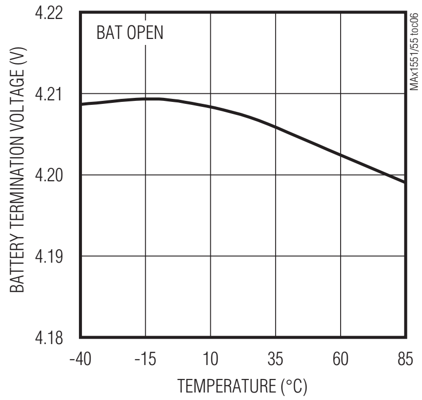

**USB CHARGE CURRENT vs. BATTERY VOLTAGE**



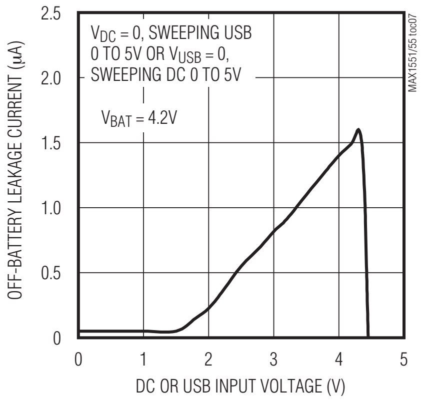

**DC CHARGE CURRENT vs. AMBIENT TEMPERATURE**



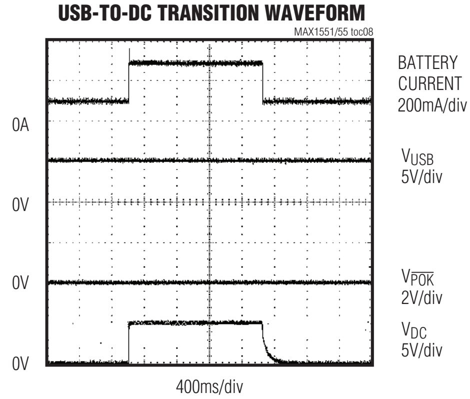

**BATTERY TERMINATION VOLTAGE vs. TEMPERATURE**




**OFF-BATTERY LEAKAGE CURRENT vs. DC INPUT VOLTAGE**




**USB-TO-DC TRANSITION WAVEFORM**



## 引脚说明

| 引脚 | 名称 | 功能 |
|---|---|---|
| 1 | USB | USB端口充电器电源输入。USB可提供最高 100mA的电池充电电流。连接 1µF陶瓷电容至 GND为USB提供退耦。 |
| 2 | GND | 地 |
| 3 | $\overline{\text{POK}}$ | 电源就绪、低电平有效、漏极开路充电器状态指示。接通任何一路电源时，$\overline{\text{POK}}$拉低 (仅 MAX1551)。 |
| 3 | $\overline{\text{CHG}}$ | 低电平有效、漏极开路充电状态指示。当电池充电时 $\overline{\text{CHG}}$为低电平。如果 $\overline{\text{CHG}}$变为高阻态，表明电池已经充满，此时充电器处于电压模式、充电电流降低至 50mA以下。当两个输入源均为低电平时，$\overline{\text{CHG}}$为高阻态 (仅 MAX1555)。 |
| 4 | DC | AC适配器的 DC充电器电源输入。DC电源提供 280mA的电池充电电流。连接 1µF陶瓷电容至 GND为DC提供退耦。 |
| 5 | BAT | 接电池。连接 1µF陶瓷电容至 GND为 BAT提供退耦。 |

## 详细说明

MAX1551/MAX1555可使用 USB或 AC适配器电源对单节Li+电池进行充电，使便携产品的用户无须携带墙上适配器。这些器件工作时无需外部场效应管或二极管，并可工作在高达 7V的输入电压。

内部温度控制环路简化了 PC板的布局，并允许优化充电速率，使其在电池状况最差、输入电压最高的情况下不会达到温度限制值；而当 MAX1551/MAX1555达到温度限制的门限时，充电器不会关断，而是逐步减小充电电流，电流会按照管芯温度超过 +110°C的部分以 17mA/°C的速度降低。

当与 USB连接、但没有 DC电源时，充电电流被置为 100mA (最大值)。这样，加电或未加电的 USB集线器均可用于充电，无需端口通信。当连接了 DC电源时，充电电流被置为 280mA (典型值)。MAX1551/MAX1555没有使能输入，只要电源连接到 USB和/或 DC，充电器就开始工作。

当输入电源被移走时，电池漏电流低于 5µA。无须使用输入屏蔽二极管来防止电池漏电。如果需要在负压输入(极性相反的适配器插入)时为电路提供保护，可在 DC (适配器输入)端插入一个二极管。

### USB与适配器电源的切换

MAX1551/MAX1555可使用 USB输入或DC输入进行充电，但并非同时使用两路电源为电池充电。MAX1551/MAX1555自动检测有效的输入并用其进行充电。如果两个电源均有效，则优先使用 DC输入。表1详细描述了 DC和 USB间的切换。

### MAX1551电源就绪 ($\overline{\text{POK}}$)

MAX1551的 $\overline{\text{POK}}$引脚为低电平有效、漏极开路输出，当 $V_{DC}$或 $V_{USB}$高于 3.95V时置为低电平。$\overline{\text{POK}}$可以用作逻辑输出或驱动一个LED。$\overline{\text{POK}}$指示充电器是否连接了输入电源并正在进行充电。

### MAX1555充电状态 ($\overline{\text{CHG}}$)

MAX1555的 $\overline{\text{CHG}}$引脚为低电平有效、漏极开路充电状态指示输出。当电池正在充电 (无论是 USB还是 DC供电)且充电电流高于 50mA时，$\overline{\text{CHG}}$被拉至低电平。当充电器处在电压模式且充电电流跌至 50mA以下时，$\overline{\text{CHG}}$引脚变为高阻状态，表示电池已充满。当 $\overline{\text{CHG}}$变高时，充电过程并不停止。在预充电模式下，$\overline{\text{CHG}}$为低电平。

### 表1、 USB和 DC输入选择

| $V_{DC}$ > 7V OR $V_{USB}$ > 6V | $V_{DC}$ > 3.95V AND $V_{USB}$ DON'T CARE | $V_{DC}$ < 3.52V AND 3.95V < $V_{USB}$ < 6V | $V_{DC}$ AND $V_{USB}$ < 3.52V |
|---|---|---|---|
| Exceeds operating input range. Not allowed. See the *Absolute Maximum Ratings* section. | 280mA (typ) charging from DC | 100mA (max) charging from USB | Undervoltage lockout |

*($V_{DC}$ takes precedence when both inputs are present.)*

# SOT23封装、USB/AC适配器双输入、单节Li+电池充电器

### 预充电电流

MAX1551/MAX1555的预充电电流可以保护深度放电的电池。如果 $V_{BAT}$低于 3V，器件会进入预充电模式，在这种模式下，充电电流被限制为 40mA。

### 封装温度限制电路

MAX1551/MAX1555片内的温度限制电路简化了 PC板的布局，并允许优化充电速率，使其在电池状况最差、输入电压最高的情况下不会达到温度限制值。器件通过降低 BAT的功耗防止过热，允许电路板针对紧凑的尺寸和典型的散热条件进行优化设计。当 MAX1551/MAX1555达到温度门限时，充电器并不关断，而是逐渐减小充电电流，电流会按照管芯温度超过 +110°C的部分以 17mA/°C的速度降低。MAX1551/MAX1555的 GND接至一个很大的接地平面，有助于功率消散并保证管芯温度低于温度门限。100mA的 USB充电电流不会导致过热问题。

### 旁路电容

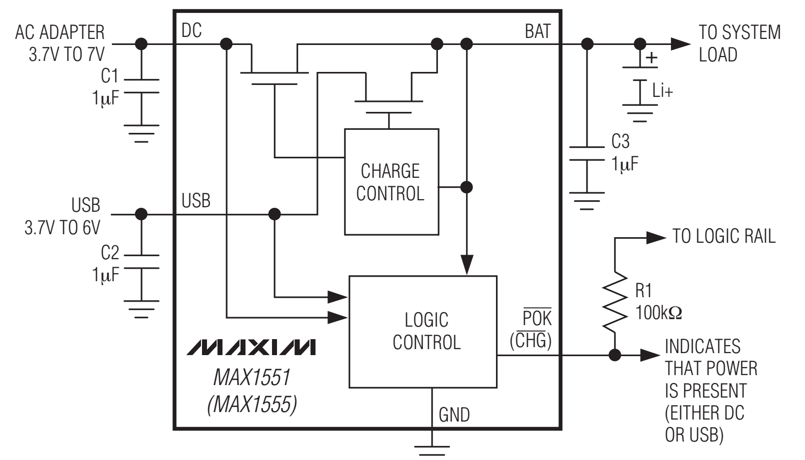
在 DC、USB和 BAT引脚应使用陶瓷旁路电容，这些电容需要安装在相应引脚的 1cm以内，推荐使用 X5R或 X7R电介质的电容。

## 芯片信息

TRANSISTOR COUNT: 541

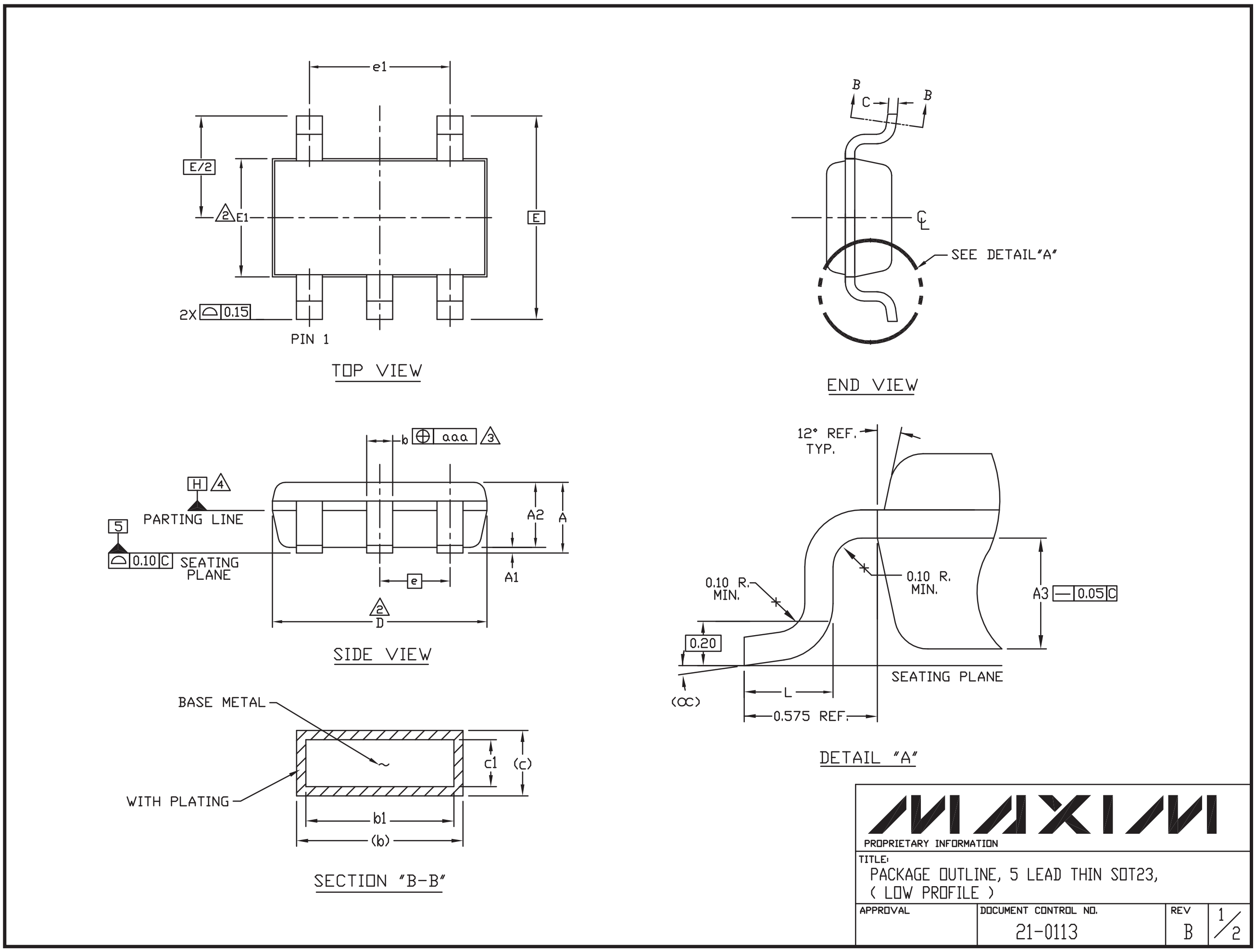
PROCESS: BiCMOS

## 典型应用电路



## 封装信息

(本数据资料提供的封装图可能不是最近的规格，如需最近的封装外型信息，请查询 **www.maxim-ic.com/packages**。)



# SOT23封装、USB/AC适配器双输入、单节Li+电池充电器

## 封装信息 (续)

(本数据资料提供的封装图可能不是最近的规格，如需最近的封装外型信息，请查询 **www.maxim-ic.com/packages**。)

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. "D" AND "E1" ARE REFERENCE DATUM AND DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, AND ARE MEASURED AT THE BOTTOM PARTING LINE. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15mm ON "D" AND 0.25mm ON "E" PER SIDE.
3. THE LEAD WIDTH DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.07mm TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION.
4. DATUM PLANE "H" LOCATED AT MOLD PARTING LINE AND COINCIDENT WITH LEAD, WHERE LEAD EXITS PLASTIC BODY AT THE BOTTOM OF PARTING LINE.
5. THE LEAD TIPS MUST LINE WITHIN A SPECIFIED TOLERANCE ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL LINES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-]; AND THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED. FORMED LEADS SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITH 0.10mm AT SEATING PLANE.
6. THIS PART IS COMPLIANT WITH JEDEC SPECIFICATION MO-193 EXCEPT FOR THE "e" DIMENSION WHICH IS 0.95Mmm INSTEAD OF 1.00mm. THIS PART IS IN FULL COMPLIANCE TO EIAJ SPECIFICATION SC-74.

| SYMBOLS | MIN | NOM | MAX |
|---|---|---|---|
| A | - | - | 1.10 |
| A1 | 0.05 | 0.075 | 0.10 |
| A2 | 0.85 | 0.88 | 0.90 |
| A3 | 0.50 BSC | | |
| b | 0.30 | - | 0.45 |
| b1 | 0.25 | 0.35 | 0.40 |
| c | 0.15 | - | 0.20 |
| c1 | 0.12 | 0.127 | 0.15 |
| D | 2.80 | 2.90 | 3.00 |
| E | 2.75 BSC | | |
| E1 | 1.55 | 1.60 | 1.65 |
| L | 0.30 | 0.40 | 0.50 |
| e1 | 1.90 BSC | | |
| e | 0.95 BSC | | |
| $\alpha$ | 0° | 4° | 8° |
| aaa | 0.20 | | |

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 5 LEAD THIN SOT23, ( LOW PROFILE )
APPROVAL | DOCUMENT CONTROL NO. 21-0113 | REV B | 2/2


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